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(54) Reinforced product consisting of a slab of natural stone or conglomerate material.

(57) By forming a grid of grooves (12) in one side of a slab (10) of natural stone (marble, granite, porphyry) or conglomerate material and anchoring therein a linear reinforcing member (16) made of metal, organic fibre or inorganic fibre, said anchoring being achieved by means of an organic or inorganic binder (20), the resistance of the slab (10) to bending and fragmentation is increased.

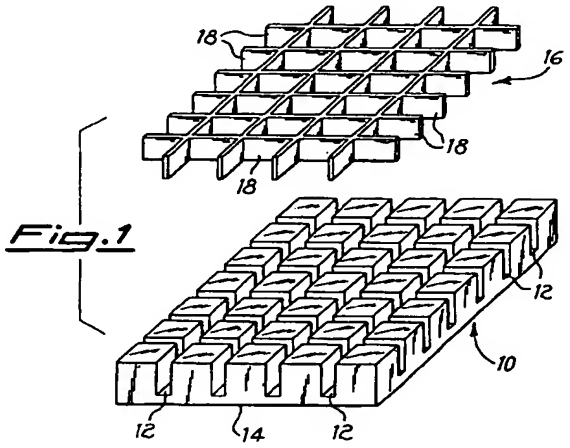

Fig.1

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The present invention relates to novel products made from natural stone or conglomerates of stone or ceramic material, in particular in the form of reinforced slabs for floors and linings in the building sector.

In the description below, "natural stone" is understood as meaning granite, marble, porphyry, or a material which is used for floors and for lining the interior and in particular the exterior of buildings. The term "conglomerate" on the other hand is understood as meaning products made from mixtures of particles of stone or ceramic material and an inorganic or organic binder, which are hardened using the processes known in the art.

In the case of the abovementioned applications, namely floors and linings, the abovementioned materials are used in the form of thin slabs having dimensions which are as large as possible.

These slabs give rise to a few problems and drawbacks of a mechanical nature, namely poor bending strength and fragility under exceptional loads.

These drawbacks or defects of the slabs in question are of critical importance in certain applications.

In the case of so-called suspended floors, i.e. those floors where a cavity is provided between the reinforced concrete base and the slab, for example in order to house the components of electrical and telephone installations and the piping of heating systems (as occurs particularly frequently in environments intended for offices and commercial or industrial use), the poor bending strength means that the slabs must have small dimensions.

In the case of internal and external building linings, on the other hand, the poor resistance to loads and exceptional stresses, as may occur in the case of earthquakes and gales, and hence the fragility of the slabs, may result in the breaking-off of fragments from the slabs themselves, with serious risks for people and property.

In the past, measures have been suggested for overcoming these problems and drawbacks, but all of the solutions proposed involved solely synthetic materials, albeit based on particles of stone material, and consisted substantially in embedding reinforcing members in the synthetic material, in the same way as when concrete products are reinforced.

These solutions, however, have not provided satisfactory results in the case of slabs of limited thickness, such as precisely those intended for flooring, and in particular are not applicable to natural stone slabs.

The aim of the present invention is precisely that of providing a technically valid and industrially advantageous solution for the abovementioned problems which can be used in particular for slabs of natural stone intended for flooring and the external lining of buildings.

To achieve this aim the present invention provides a slab-like product of natural stone or conglomerate material, which is characterized in that it is formed by a slab containing in one of its main surfaces a grid of grooves each having a depth sufficient for housing therein a linear reinforcing member, said reinforcing member being permanently anchored inside the groove by a binder. In the preferred embodiment of the present invention the product consists of a slab of natural stone, such as marble, porphyry or granite, in the rear surface of which, i.e. the surface not intended to remain in view after laying, a grid of grooves having a depth preferably not less than half of the thickness of the slab is formed, and a plurality of reinforcing members chosen from metal, organic and inorganic fibres, metal or synthetic strands and metal or synthetic lattices or meshwork is housed in said grid, said plurality of reinforcing members being anchored in said grooves by a binder chosen from synthetic resins and inorganic binders substantially not subject to shrinkage after hardening.

In a further variation of embodiment of the present invention, lugs for anchoring the product during laying are associated with said plurality of reinforcing members.

Further aspects and advantages of the present invention will appear more clearly from the detailed description which follows provided with reference to the accompanying drawings in which:

Fig. 1 is an exploded perspective view of the product of the present invention prior to its actual assembly;

Fig. 2 is a plan view of the same product in its complete state;

Fig. 3 is a section along the plane III-III of Fig. 2;

Fig. 4 is a view, similar to Fig. 3, of a variation of embodiment of grooves formed in the slab of natural stone;

Fig. 5 is a view, similar to Fig. 3, but on a larger scale, of a further variation of embodiment;

Figs. 6 and 7 are views, similar to Fig. 3, of further variations of embodiment of the product according to the invention;

With reference first of all to Fig. 1, this shows a slab 10 of natural stone which has a plurality of grooves 12 which intersect and form a regular grid.

It is important to mention that the grooves 12 extend to a considerable depth in the thickness of the slab 10, leaving a small residual thickness behind the surface 14 which normally is that surface which is intended to remain in view or form the external surface of the floor or wall lining.

The reinforcing member 16 is seated in the grid of grooves 12 and in this case consists of a latticework of metal bars or strips 18 with a width

and depth such that they can be accommodated inside the grooves 12.

It should be noted that the formation of the grooves 12 in the slab 10 does not pose any difficulties since it is a normal operation involving machining of natural stone, for which a suitable cutting tool is sufficient.

From Figures 2 and 3 it is possible to see what the end product looks like, Fig. 2 showing the rear side 22, namely the side on which the grooves 12 are formed before receiving the grid 16 and the binding material 20.

As regards the binding material, it consists preferably of a synthetic resin which is able to fix itself inside the grooves 12 and is not incompatible with the material forming the reinforcing grid.

In particular, when the grid 16 is made from glass fibre, the synthetic resin may be a polyester resin whereas, when the grid is made from the material known as Kevlar, the synthetic resin may be a polyester resin or an epoxy resin. In the case where the grid 16 is made up of steel strips, in addition to the aforementioned synthetic resins, it is also possible and intended to use a cement, provided that it is of the so-called anti-shrinkage kind, namely shrinks by a very small amount during setting and hardening.

It is important to emphasize the fact that, according to the present invention, the slab-like product of natural stone, whilst having the same thickness compared to the original natural-stone slab, increases the bending strength by an amount greater than the simple addition of the mechanical strengths of the original slab and the reinforcing material.

Moreover, as is clear, in the event of exceptional stresses, as for example in the case of earthquakes, the reinforcing grid 16 combined with the binder 20 prevents the separation of fragments which, especially in the case of external wall linings, represent a serious danger for people and property.

Figure 4 shows a variation of embodiment which differs from that of Fig. 3 solely in that the grooves 24 initially formed in the rear face 22 of the slab 10 are inclined rather than perpendicular to the face itself.

In this way it improves anchoring of the strips 18 forming the grid 16 inside the grooves themselves.

With reference now to Fig. 5 it can be clearly seen that in this case the reinforcing member consists of a plurality of strands 26 which may be interwoven so as to form a cord. The strands 26 may be made of synthetic material or steel, the other features remaining the same, except that they will be arranged inside the grooves 12 without a grid 16 being formed first.

The embodiment of Fig. 6 shows a variation of the solution of Fig. 3, in which the strips 18 have lugs 28 of a suitable length for anchoring the resultant slab-like product in a base consisting for example of cement or a supporting structure, during laying.

This embodiment assumes particularly importance in the case of external wall linings, since it further improves the resistance to fragmentation and separation of pieces of slab during exceptional stresses.

The embodiment of Fig. 7 represents a variation of that shown in Fig. 6 since the lugs 28 have associated with them further members 30 for anchoring the slab, preferably provided with shrinkage relief holes 32.

It is important to emphasize that the grid 16 represents the preferred embodiment and that it may equally well be made of metal, in which case it is manufactured by means of welding, or of plastic, in which case it may be manufactured for example by means of injection or moulding.

As regards the conditions for achieving hardening of the binder which fills the grooves and anchors the reinforcing members in their interior, it is obvious that these conditions depend on the nature of the binder itself. The nature of the material forming the slab facilitates the operation since thermal hardening is also possible without damaging the final product.

The invention has been described in relation to a few preferred embodiments, without the latter having to be regarded as restrictive, since further conceptually and mechanically equivalent modifications and variations are possible and may be envisaged without departing from the scope thereof. For example, if one wishes to obtain special decorative effects, a suitable colouring agent may be added to the binder 20, in which case the rear surface 22 of the slab becomes that which is intended to remain in view, without any variation in the mechanical properties and performance of the product.

Equally possible is a non-regular arrangement of the grooves housing the reinforcing members, for example in order to increase the strength of particular portions of the slab depending on specific needs or requirements.

Claims

1. Slab-like product of natural stone or conglomerate material, characterized in that it is formed by a slab containing in one of its main surfaces a plurality of grooves each having a depth sufficient for housing therein a linear reinforcing member, said reinforcing member being permanently anchored within the groove by a binder.

2. Product according to Claim 1, characterized in that said slab consists of a natural stone chosen from marble, porphyry and granite.

3. Product according to Claim 1, characterized in that said plurality of grooves forms a regular grid.

4. Product according to Claim 1, characterized in that said linear reinforcing member is chosen from fibres, cords, strands or a meshwork lattice.

5. Product according to Claim 4, characterized in that said linear reinforcing member is made of a material chosen from metal materials or inorganic or organic fibres.

6. Product according to Claim 5, characterized in that said metal material is steel.

7. Product according to Claim 3, characterized in that said synthetic fibres consist of carbon or Kevlar.

8. Product according to Claim 1, characterized in that said binder is chosen from organic binders which can be anchored to natural stone and cement.

9. Product according to Claim 8, characterized in that said organic binder is chosen from polyester resins and epoxy resins.

10. Product according to Claim 8, characterized in that said cement is of the anti-shrinkage type.

11. Product according to Claim 1, characterized in that the depth of each said groove is not less than half of the thickness of said slab.

12. Product according to Claim 1, characterized in that each groove has a predetermined inclination with respect to the outer surface of the slab in which said grooves are formed.

13. Product according to Claim 1, characterized in that said linear reinforcing members have associated therewith lugs projecting from the surface of the slab in which said grooves are formed, said lugs protruding by a predetermined height for anchoring the product in a cement base or to a supporting structure.

14. Product according to Claim 13, characterized in that associated with said lugs are plate-shaped members provided with holes for anchoring the product in a laying mortar or in a supporting structure.

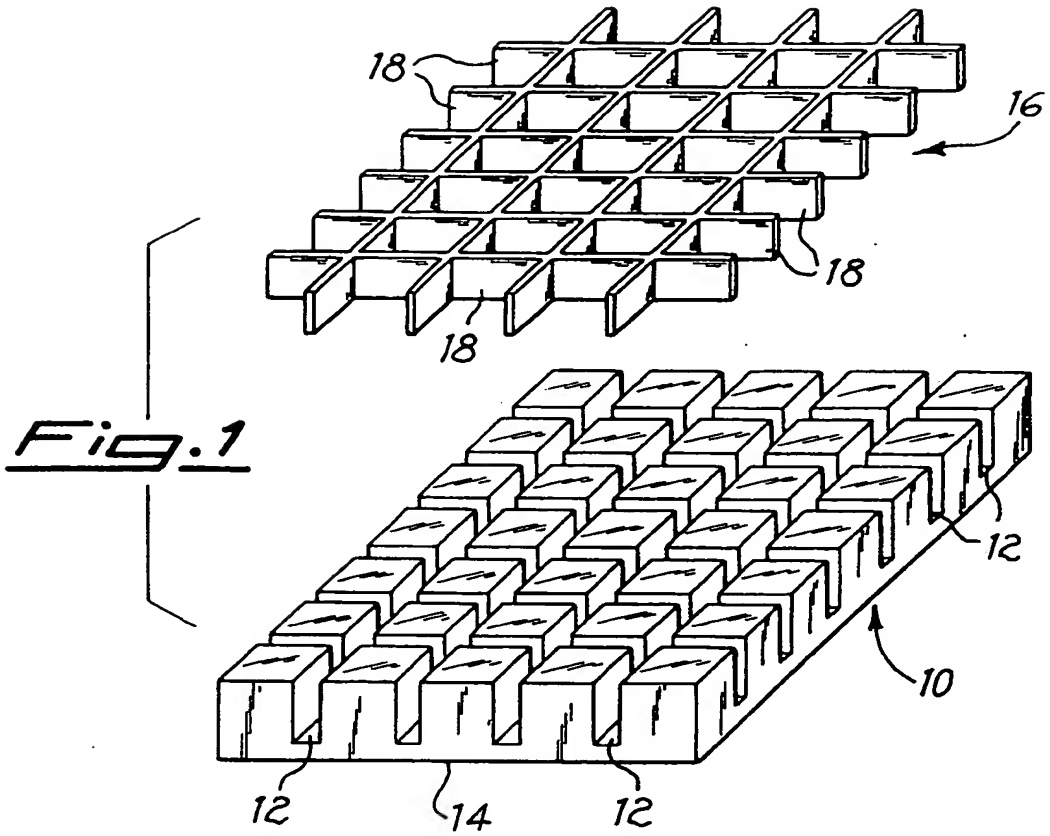

Fig.1

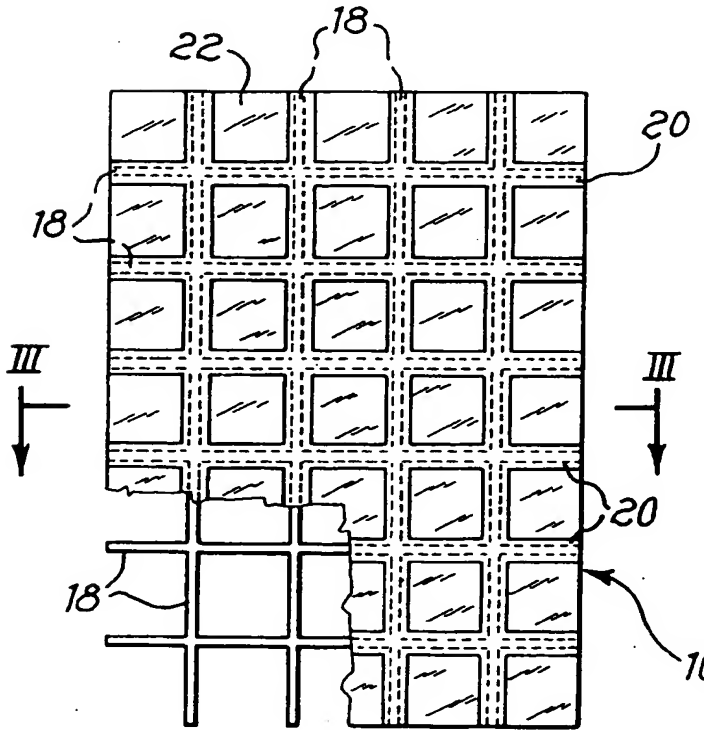

Fig.2

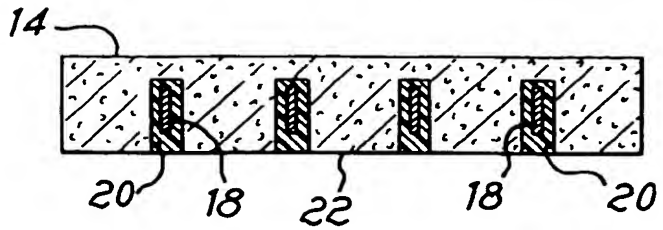

Fig.3

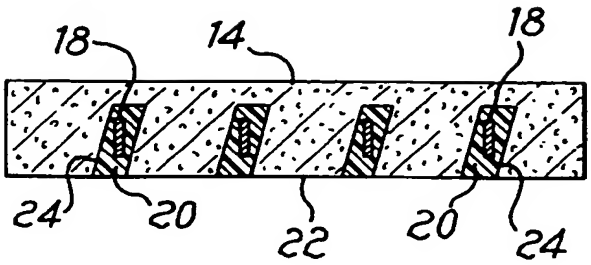

Fig.4

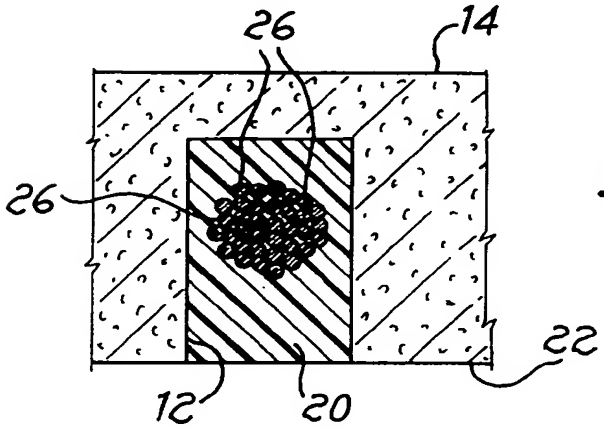

Fig.5

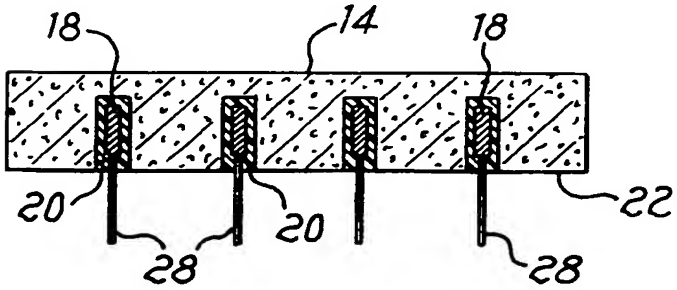

Fig.6

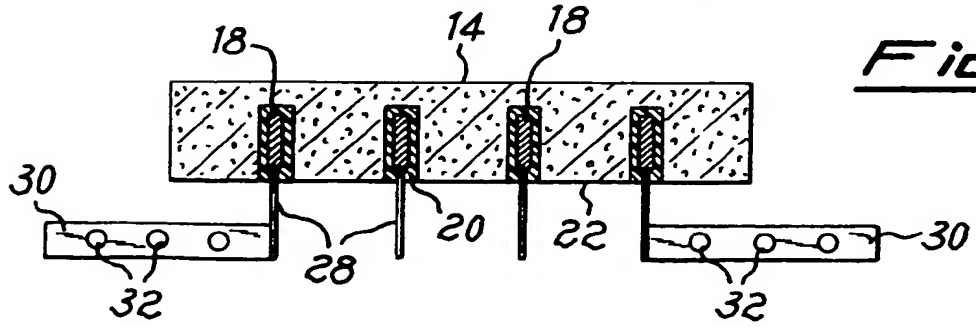

Fig.7

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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 1852

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	BE-A-413 816 (NICOLLE) * the whole document *	1,3-6 2,8,9,13	E01C5/08 E01C5/22
Y A	GB-A-455 470 (BRAY) * the whole document *	2,8,9 1	
Y A	US-A-4 660 344 (GAUDELLI) * figures 10,11 *	13 1	
Y	CH-A-631 509 (MAURINO) * the whole document *	1-8,12	
Y	DE-A-23 48 341 (FORSCH. BAUTECHN.) * the whole document *	1-8,12	
A	GB-A-M30146 (GIBSON) & GB-A-30146 A.D. 1910 * the whole document *	1,4,5,6, 14	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

E01C
E04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 November 1993	DIJKSTRA, G

CATEGORY OF CITED DOCUMENTS

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